September 3, 2014

Dr. Sean McDeavitt, Interim Director
Nuclear Science Center
Texas Engineering Experiment Station
Texas A&M University Sytem
1095 Nuclear Science Road, MS 3575
College Station, TX 77843-3575

SUBJECT: EXAMINATION REPORT NO. 50-128/OL-14-02, TEXAS A&M UNIVERSITY, REVISED

Dear Dr. McDeavitt:

Upon receipt of a candidates request for an informal review on July 22, 2014, because he had failed the written examination given on June 13, 2014 and received a proposed denial of his operator license, the staff reviewed the applicant's contention and overturned the proposed license denial. The examination was conducted according to NUREG-1478, "Operator Licensing Examiner Standards for Research and Test Reactors," Revision 2. Examination questions and the failed candidates contentions were discussed with those members of your staff identified in the enclosed report at the conclusion of the informal review process. After the candidates's informal review, the answer to Question C .03 was amended to show the correct answer.

In accordance with Title 10 of the *Code of Federal Regulations* Section 2.390, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Phillip T. Young at (301) 415-4094 or via electronic mail Phillip.young@nrc.gov.

Sincerely,

/RA/

Kevin Hsueh, Chief
Research and Test Reactors Oversight Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-128

Enclosures:
1. Revised Examination Report No. 50-128/OL-14-02
2. Revised Written examination comments and resolution
3. Revised Written examination

cc w/o enclosures: See next page

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DATE	8/22/2014	8/28/2014	9/03/2014

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cc:

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ENCLOSURE 1

U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT-REVISED

REPORT NO.: 50-128/OL-14-02

FACILITY DOCKET NO.: 50-128

FACILITY LICENSE NO.: R-83

FACILITY: TEXAS A&M UNIVERSITY

EXAMINATION DATES: June 13, 201

SUBMITTED BY: **/RA/** 08/28/2014
Philip T. Young, Chief Examiner Date

SUMMARY: Revision

During the week of June 9, 2014, retake operator licensing written examinations were administered, an incorrect answer key resulted in the failure of one applicant. A regrade of the examination resulted in all applicants passing all portions of the examination.

REPORT DETAILS

1. Examiners: Philip T. Young, Chief Examiner

2. Results:

	RO PASS/FAIL	**SRO PASS/FAIL**	**TOTAL PASS/FAIL**
Written	3/0	N/A	3/0
Operating Tests	N/A	N/A	N/A
Overall	3/0	N/A	3/0

3. Exit Meeting:

No exit meeting was conducted for this retake examination.

ENCLOSURE 1

REVISED FACILITY COMMENTS WITH NRC RESOLUTION

Texas A&M University, provided the following comment on the written examination on July 1, 2014
I was wondering if you could look at question C.003 of the exam given 6/13/14 here. The given answer on the exam key is “a” with a reference to SAR, page 93. I think there was a mix-up on this question. The correct answer to C.003 is “b” referencing SAR 7.2.3.4 Servo Control System on page 108. There’s definitely not, and never has been, a scram associated with the servo control. It just shifts back to manual. I wouldn’t say anything and make the extra work for you, but the answer key being correct on this point changes the outcome of William Winters’ exam and that’s very important to us.

Question: **C.03**
Comment: I was wondering if you could look at question C.003 of the exam given 6/13/14 here. The given answer on the exam key is “a” with a reference to SAR, page 93. I think there was a mix-up on this question. The correct answer to C.003 is “b” referencing SAR 7.2.3.4 Servo Control System on page 108. There’s definitely not, and never has been, a scram associated with the servo control. It just shifts back to manual.

Justification: See comments above.

NRC Resolution: After completing the informal review requested by the applicant, and considering the facility explanation, answer “b” will be accepted with the grading changed accordingly.

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER INITIAL REACTOR LICENSE EXAMINATION- REVISED

FACILITY: TEXAS A&M UNIVERSITY

REACTOR TYPE: TRIGA

DATE ADMINISTERED: 6/13/2014

CANDIDATE: ______________________________

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in brackets for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

Category Value	% of Total	% of Candidates Score	Category Value	Category
20.00	33.3	______	____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
20.00	33.3	______	____	B. Normal and Emergency Operating Procedures and Radiological Controls
20.00	33.3	______	____	C. Facility and Radiation Monitoring Systems
60.00		______	____% FINAL GRADE	TOTALS

All work done on this examination is my own. I have neither given nor received aid.

____
Candidate's Signature

NRC RULES AND GUIDELINES FOR LICENSE EXAMINATIONS

During the administration of this examination the following rules apply:

1. Cheating on the examination means an automatic denial of your application and could result in more severe penalties.

2. After the examination has been completed, you must sign the statement on the cover sheet indicating that the work is your own and you have neither received nor given assistance in completing the examination. This must be done after you complete the examination.

3. Restroom trips are to be limited and only one candidate at a time may leave. You must avoid all contacts with anyone outside the examination room to avoid even the appearance or possibility of cheating.

4. Use black ink or dark pencil <u>only</u> to facilitate legible reproductions.

5. Print your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.

6. Mark your answers on the answer sheet provided. USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.

7. The point value for each question is indicated in [brackets] after the question.

8. If the intent of a question is unclear, ask questions of the examiner only.

9. When turning in your examination, assemble the completed examination with examination questions, examination aids and answer sheets. In addition turn in all scrap paper.

10. Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.

11. To pass the examination you must achieve a grade of 70 percent or greater in each category.

12. There is a time limit of three (3) hours for completion of the examination.

13. When you have completed and turned in you examination, leave the examination area. If you are observed in this area while the examination is still in progress, your license may be denied or revoked.

$$\dot{Q} = \dot{m} c_p \Delta T = \dot{m} \Delta H = UA \Delta T$$

$$\lambda_{eff} = 0.1 \ seconds^{-1}$$

$$SUR = 26.06 \left[\frac{\lambda_{eff} \rho}{\beta - \rho} \right]$$

$$SCR = \frac{S}{-\rho} \approx \frac{S}{1 - K_{eff}}$$

$$CR_1 (1 - K_{eff_1}) = CR_2 (1 - K_{eff_2})$$

$$CR_1 (-\rho_1) = CR_2 (-\rho_2)$$

$$M = \frac{1 - K_{eff_0}}{1 - K_{eff_1}}$$

$$M = \frac{1}{1 - K_{eff}} = \frac{CR_1}{CR_2}$$

$$P = P_0 \, 10^{SUR(t)}$$

$$P = P_0 \, e^{\frac{t}{T}}$$

$$P = \frac{\beta (1 - \rho)}{\beta - \rho} P_0$$

$$SDM = \frac{(1 - K_{eff})}{K_{eff}}$$

$$T = \frac{\ell^*}{\rho - \overline{\beta}}$$

$$T = \frac{\ell^*}{\rho} + \left[\frac{\overline{\beta} - \rho}{\lambda_{eff} \rho} \right]$$

$$\rho = \frac{(K_{eff} - 1)}{K_{eff}}$$

$$\Delta \rho = \frac{K_{eff_2} - K_{eff_1}}{k_{eff_1} \, x \, K_{eff_2}}$$

$$T_{1/2} = \frac{0.693}{\lambda}$$

$$DR = DR_0 \, e^{-\lambda t}$$

$$DR = \frac{6CiE(n)}{R^2}$$

$$DR_1 d_1^{\,2} = DR_2 d_2^{\,2}$$

DR – Rem, Ci – curies, E – Mev, R – feet

$$\frac{(\rho_2 - \beta)^2}{Peak_2} = \frac{(\rho_1 - \beta)^2}{Peak_1}$$

1 Curie = 3.7×10^{10} dis/sec
1 Horsepower = 2.54×10^{3} BTU/hr
1 BTU = 778 ft-lbf
1 gal (H_2O) ≈ 8 lbm
c_P = 1.0 BTU/hr/lbm/°F

1 kg = 2.21 lbm
1 Mw = 3.41×10^{6} BTU/hr
°F = 9/5 °C + 32
°C = 5/9 (°F - 32)
c_p = 1 cal/sec/gm/°C

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.001 [1 point] (1.0)
Which ONE of the following statements is correct with respect to why Xenon peaks following a shutdown?

a. The delayed neutrons continue causing fissions increasing the “direct” Xenon.

b. The decay constant for Xenon is longer than the decay constant for Iodine.

c. The decay constant for Xenon is longer than the decay constant for Cesium.

d. The decay constant for Cesium is essentially zero.

Answer: A.01 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §

Question A.002 [1 point] (2.0)
When a reactor is prompt critical, the neutron multiplication rate is determined by:

a. the value of β_{eff}.

b. the generation time of prompt neutrons only.

c. the generation time of delayed neutrons only.

d. the half-life of the shortest-lived delayed neutron precursor.

Answer: A.02 b.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 4-3.

Question A.003 [1 point] (3.0)
A 1/M curve is being generated as fuel is loaded into the core. After some fuel elements have been loaded, the count rate existing at that time is taken to be the new initial count rate, C_o. Additional elements are then loaded and the inverse count rate ratio continues to decrease. As a result of changing the initial count rate:

a. criticality will occur earlier (i.e. with fewer elements loaded.)

b. criticality will occur later (i.e. with more elements loaded.)

c. criticality will occur with the same number of elements loaded.

d. criticality will be completely unpredictable.

Answer: A.03 c.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 5-18.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.004 [1 point] (4.0)

About two minutes following a reactor scram, period has stabilized, and is decreasing at a CONSTANT rate. If reactor power is 10^{-5} % full power what will the power be in three minutes.

a. 5×10^{-6} % full power

b. 2×10^{-6} % full power

c. 10^{-6} % full power

d. 5×10^{-7} % full power

Answer: A.04 c.

Reference: $P = P_0\, e^{-T/\tau} = 10^{-5} \times e^{(-180sec/80sec)} = 10^{-5} \times e^{-2.25} = 0.1054 \times 10^{-5} = 1.054 \times 10^{-6}$

Question A.005 [1 point] (5.0)

Core excess reactivity (ρ_{ex}) changes with …

a. fuel element burnup

b. control rod height

c. neutron energy level

d. reactor power level

Answer: A.05 a.

Reference: Reactor Training Manual - Core Excess and Shutdown Margin.

Question A.006 [1 point] (6.0)

The term “reactivity” may be described as …

a. a measure of the core’s fuel depletion.

b. negative when K_{eff} is greater than 1.0.

c. a measure of the core’s deviation from criticality.

d. equal to \$.50 when the reactor is prompt critical.

Answer: A.06 c.

Reference: Reactor Training Manual - Reactivity

Question A.007 [1 point] (7.0)

TIME	ACTIVITY
0 minutes	2400 cps
10 minutes	1757 cps
20 minutes	1286 cps
30 minutes	941 cps
60 minutes	369 cps

Given the data in the table to the right, which ONE of the following is the closest to the half-life of the material?

a. 11 minutes
b. 22 minutes
c. 44 minutes
d. 51 minutes

Answer: A.07 b.
Reference: Reactor Training Manual - Reactivity

Question A.008 [1 point] (8.0)
A fissile material is one which will fission upon the absorption of a THERMAL neutron. Which ONE of following listed isotopes is not a fissile material?

a. Th^{232}
b. U^{233}
c. U^{235}
d. Pu^{239}

Answer: A.08 a.
Reference: Glasstone and Sesonske, Third Ed. § 1.45

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.009 [1 point] (9.0)
Assume that the NSCR pool contains 106, 000 gallons at 90 degrees F and it heats up to 93 degrees F in two hours at indicated 400Kw. Assume no heat is removed from the pool. Based on your calculation results you should recommend to the SRO:

a. Make adjustment to correct the linear power channel indication.

b. Add more ice to the bath and wait two more hours.

c. Lower the reactor power to the steady state power calculated.

d. Maintain the power and wait for the ice bath to melt some more.

Answer: A.09 a.
Reference: Q=mc(Tfin-Tini) where: m=106,000 gal.x 8lbm/gal=848,000 lbm; c=1 BTU/□F-lbm; Tfin=93 and Tini=90. Q=848,000 lbmx1BTU/□F-lbmx1.5□F=1.0272E6 BTU/hr x 2.93E-4 = 373Kw]

Question A.010 [1 point] (10.0)
Which ONE of the following explains the response of a <u>SUBCRITICAL</u> reactor to equal insertions of positive reactivity as the reactor approaches criticality?

a. Each insertion causes a SMALLER increase in neutron flux resulting in a LONGER time to stabilize.

b. Each insertion causes a LARGER increase in neutron flux resulting in a LONGER time to stabilize.

c. Each insertion causes a SMALLER increase in neutron flux resulting in a SHORTER time to stabilize.

d. Each insertion causes a LARGER increase in neutron flux resulting in a SHORTER time to stabilize.

Answer: A.10 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §

Question A.011 [1 point] (11.0)
K_{eff} for the reactor is 0.85. If you place an experiment worth +17.6% into the core, what will the new K_{eff} be?

a. 0.995

b. 0.9995

c. 1.005

d. 1.05

Answer: A.11 b.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, §
SDM = $(1-k_{eff})/k_{eff}$ = (1-0.85)/0.85 = 0.15/0.85 = 0.1765, or a reactivity worth (ρ) of -0.1765. Adding + 0.176 reactivity will result in a SDM of 0.1765 - 0.1760 = 0.0005. K_{eff} = 1/(1+SDM) = 1/(1 + 0.0005) = 0.9995

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.012 [1 point] (12.0)
The term PROMPT JUMP refers to …

a. the instantaneous change in power due to withdrawal of a control rod.

b. a reactor which has attained criticality on prompt neutrons alone.

c. a reactor which is critical on both prompt and delayed neutrons.

d. a negative reactivity insertion which is less than β_{eff}.

Answer: A.12 a.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1988, § 4.7, p. 4-21

Question A.013 [1 point] (13.0)
Inelastic Scattering is the process whereby a neutron collides with a nucleus and:

a. recoils with the same kinetic energy it had prior to the collision.

b. recoils with a lower kinetic energy, with the nucleus emitting a gamma ray.

c. is absorbed by the nucleus, with the nucleus emitting a gamma ray.

d. recoils with a higher kinetic energy, with the nucleus emitting a gamma ray.

Answer: A.13 b.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, pg. 2-28.

Question A.014 [1 point] (14.0)
An experiment to be placed in the central thimble has been wrapped in cadmium. Which one of the following types of radiation will be most effectively blocked by the cadmium wrapping?

a. Thermal neutrons

b. Fast neutrons

c. Gamma rays

d. X-rays

Answer: A.14 a.
Reference: Glasstone, S. and Sesonske, 1991, § 10.34, pp. 639.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.015 [1 point] (15.0)
With the reactor critical at 10 KW a rod is pulled to insert a positive reactivity of 0.00126 ΔK/K. Which one of the following will be the stable reactor period as a result of this reactivity insertion?

a. 10 seconds

b. 50 seconds

c. 60 seconds

d. 70 seconds

Answer: A.15 b.
Reference: $\tau = (\beta-\rho)/\lambda_{eff}\rho = \dfrac{.0075 - .00126}{(.1)\,(.00126)} = 49.5$ seconds

Question A.016 [1 point] (16.0)
An initial count rate of 100 is doubled five times during a startup. Assuming an initial Keff of 0.950, which one of the following is the new Keff?

a. 0.957

b. 0.979

c. 0.985

d. 0.998

Answer: A.16 d.
Reference: CR1 (1-Keff1) = CR2 (1 - Keff2) or M1 (1-Keff1) = M2 (1 - Keff2)
CR2/CR1 = 32 → CR1 (1-Keff1)/CR2 = 1 - Keff2) → 100 (1-0.950)/3200 = 1 - Keff2
Keff2 = 1 - .0015625 = .998

Question A.017 [1 point] (17.0)
As a reactor continues to operate over a period of months, for a <u>constant</u> power level, the average neutron flux:

a. decreases, due to the increase in fission product poisons.

b. decreases, because fuel is being depleted.

c. increases, in order to compensate for fuel depletion.

d. remains the same.

Answer: A.17 c.
Reference: R. R. Burn, Introduction to Nuclear Reactor Operations, page 2-50.

Section A Reactor Theory, Thermo, and Facility Characteristics

Question A.018 [1 point] (18.0)
Which one of the following is a correct statement concerning the factors affecting control rod worth?

a. Fuel burn up causes the rod worth for periphery rods to decrease.

b. Fuel burn up causes the rod worth to increase in the center of the core.

c. The withdrawal of a rod causes the rod worth of the remaining inserted rods to increase.

d. As Rx power increases rod worth increases.

Answer: A.18 c.
Reference: Burn, R., Introduction to Nuclear Reactor Operations, © 1982, § 7.2 & 7.3, pp. 7-1 — 7-10.

Question A.019 [1 point] (19.0)
Pool temperature increases by 20 ºF. Given αT moderator = -0.0005 ΔK/K/ºF and an average regulating rod worth of 0.004 ΔK/K/inch. By how much and in what direction did the regulating rod move to compensate for the temperature change?

a. 0.25 inches in

b. 0.25 inches out

c. 2.5 inches in

d. 2.5 inches out

Answer: A.19 d.
Reference: +20□ F × -0.0005 ΔK/K/□F = - 0.01 ΔK/K.
To compensate the rod must add +0.01 ΔK/K. +0.01ΔK/K ÷ +0.004 ΔK/K/inch = +2.5 inches

Question A.020 [1 point] (20.0)
Which ONE of the following conditions will INCREASE the shutdown margin of a reactor?

a. Lowering moderator temperature (Assume negative temperature coefficient).

b. Insertion of a positive reactivity worth experiment.

c. Burnout of a burnable poison.

d. Fuel depletion.

Answer: A.20 d.
Reference: Standard NRC question

Section B Normal/Emergency Procedures & Radiological Controls

Question B.001 [1.0 point] {1.0}
The Design Basis Accident for the TA&M reactor is:

a. an accidental pulse at full power.

b. a loss of coolant accident (reactor pool is accidentally drained of water).

c. the loss of integrity of one fuel element cladding and the simultaneous loss of pool water.

d. the accidental insertion of an experiment with a positive reactivity worth of $1.00 while the reactor is critical.

Answer: B.01 c.
Reference: SAR Chapter XI.

Question B.002 [1.0 point] {2.0}
Which ONE of the following conditions is permissible when the reactor is operating, or about to be operated?

a. Steady state power level of 1.2 megawatts for purposes of testing.

b. A non-secured experiment worth $1.50.

c. A fuel element is known to be damaged, but has been moved to the edge of the core.

d. The Continuous Air Radiation Monitor and the Exhaust Gas Radiation Monitor are inoperable due to maintenance and have been replaced with gamma sensitive instruments with alarms.

Answer: B.02 a.
Reference: TA&M Technical Specifications, Section 3.1.1.

Question B.003 [1.0 point] {3.0}
Limiting Safety System Settings used to prevent exceeding a Safety Limit:

a. must actuate automatically before the limit is exceeded.

b. can be exceeded during transients.

c. can be changed by the Reactor Safety Board.

d. apply only in the steady state mode of operation.

Answer: B.03 a.
Reference: TA&M Technical Specifications, Section 2.2.

Section B Normal/Emergency Procedures & Radiological Controls

Question B.004 [1.0 point] {4.0}
The reactor was pulsed but the reactor was switched back to the steady state mode before the reactor operator logged the NVT and the pulse temperature values. The reactor operator should:

a. repeat the pulse.

b. look in the log book for a previous pulse of the same reactivity and use the NVT and pulse temperature values for that pulse.

c. shut down the reactor and record a statement in the Operations Log to document the event.

d. record the pulse temperature from the fuel element temperature recorder and correlate that value to the pulse power.

Answer: B.04 d.
Reference: SOP Pulsing Operation.

Question B.005 [1.0 point] {5.0}
An automatic scram signal which is NOT required by the Technical Specifications when operating in the steady state mode is:

a. short period.
b. high fuel temperature.
c. high power level.
d. loss of detector high voltage.

Answer: B.05 a.
Reference: TA&M Technical Specifications, Table 1.

Question B.006 [1.0 point] {6.0}
A startup checklist has been completed and a startup performed. The reactor is then shutdown (scheduled.) During the shutdown, the bridge is moved. When the reactor is again started up on the same day:

a. another complete checklist is required.
b. the scram circuits must be checked.
c. only section A of the checklist is required.
d. only section D of the checklist is required.

Answer: B.06 b.
Reference: SOP II-C.5, Reactor Startup.

Section B Normal/Emergency Procedures & Radiological Controls

Question B.007 [1.0 point] {7.0}
In accordance with 10CFR55, a licensed operator must:

a. pass a comprehensive requalification written examination and an annual operating test during a 24-month period.

b. complete a minimum of six hours of shift functions each month.

c. have a medical examination during the six-year term of the license.

d. notify the NRC within 30 days following an arrest.

Answer: B.07 a.
Reference: TA&M Requalification Program.

Question B.008 [1.0 point] {8.0}
Information regarding the assembly and location of each fuel bundle is found in the:

a. fuel log.

b. operations log.

c. supervisor log.

d. reactor data log.

Answer: B.08 a.
Reference: SOP Operations Records.

Question B.009 [1.0 point] {9.0}
A "Red Tag" can only be initiated by:

a. the SRO on duty.

b. any SRO.

c. any NSC staff member.

d. the Manager of Reactor Operations.

Answer: B.09 c.
Reference: SOP Red Tag Procedures.

Section B Normal/Emergency Procedures & Radiological Controls

Question B.010 [1.0 point] {10.0}
A reactor parameter which is protected by a Safety Limit is:

a. reactor power.

b. fuel element temperature.

c. fuel cladding temperature.

d. pool water level.

Answer: B.10 b.
Reference: Technical Specifications, Section 2.1.

Question B.011 [1.0 point] {11.0}
Which ONE of the following Emergency classifications is NOT used at the Texas A&M TRIGA reactor?

a. Operational Event

b. Notification of Unusual Event

c. Alert

d. General Emergency

Answer: B.11 d.
Reference: SOP IX § A Emergency Classification Guide, pp. 1 & 2

Question B.012 [1.0 point] {12.0}
Work is to be performed near a source of radiation emitting a field of 2 Mev gamma measuring 500 Mrem/hr. Considering linear attenuation coefficients of 1.15 $in.^{-1}$ and 0.575$in.^{-1}$, respectively, estimate the thickness of lead and steel (separately) in inches to reduce the radiation level to 5 Mrem/hr.
{(tenth thickness for lead is 2 inches) & (tenth thickness for steel is 4 inches)}

	lead	steel
a.	2 inches	4 inches
b.	4 inches	8 inches
c.	2 inches	10 inches
d.	4 inches	20 inches

Answer: B.12 b.
Reference: $D = D_o e^{-\mu x}$ □ $\ln D/D_o = -\mu x$ □ $x = -4.605/-\mu$ -or-
2 tenth thickness required
tenth thickness for lead is 2 inches
tenth thickness for steel is 4 inches

Section B Normal/Emergency Procedures & Radiological Controls

Question B.013 [1.0 point] {13.0}
Which ONE of the following areas is defined as " ... any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source...

a. Radiation Area

b. Restricted Area

c. High Radiation Area

d. Airborne Radioactivity Area

Answer: B.13 c.
Reference: 10CFR20, Part 20.1003

Question B.014 [1.0 point] {14.0}
Shortly after an evacuation of the reactor building, an NSC management representative arrives at the facility. Which ONE of the statements below describes a situation that warrants his/her assumption of the Emergency Director responsibilities?

a. The management representative immediately assumes the responsibilities of the Emergency Director in all cases.

b. The management representative assumes the responsibilities of the Emergency Director when the health and safety of the public are in jeopardy.

c. The management representative assumes the responsibilities of the Emergency Director only in cases where the SRO requests to be relieved.

d. The management representative assumes the responsibilities of the Emergency Director at the point where interaction with outside support organizations becomes necessary.

Answer: B.014 b.
Reference: SOP IX-B, Sect. j

Section B   Normal/Emergency Procedures & Radiological Controls

Question B.015 [1.0 point, 0.25 each] {15.0}
Match the type of radiation in column A with its associated Quality Factor (10CFR20) from column B.

Column A	Column B
a. alpha	1
b. beta	2
c. gamma	5
d. neutron (unknown energy)	10
	20

Answer: B.015 a. = 20; b. = 1; c. = 1; d. = 10
Reference: 10CFR20.100x

Question B.016 [1.0 point] {16.0}
An accessible area within the facility has general radiation levels of 325 mrem/hour. What would be the EXPECTED posting for this area?

a. "Caution, Very High Radiation Area"

b. "Danger, Airborne Radioactivity Area"

c. "Danger, High Radiation Area"

d. "Caution, Radiation Area"

Answer: B.16 c.
Reference: Reactor Training Manual - 10CFR20

Question B.017 [1.0 point, 0.25 each] {17.0}
Match type of radiation (1 thru 4) with the proper penetrating power (a thru d)

a. Gamma	1. Stopped by thin sheet of paper
b. Beta	2. Stopped by thin sheet of metal
c. Alpha	3. Best shielded by light material
d. Neutron	4. Best shielded by dense material

Answer: B.17 a. = 4; b. = 2; c. = 1; d. = 3
Reference: Reactor Training Manual - Health Physics

Section B Normal/Emergency Procedures & Radiological Controls

Question B.018 [1.0 point] {18.0}
Which ONE of the following is the MAXIMUM amount of explosive materials allowed in the building per Technical Specification 3.6.2?

a. 25 milligrams

b. 5 grams

c. 5 pounds

d. 25 pounds

Answer: B.18 c.
Reference: Technical Specification 3.6.2

Question B.019 [1.0 point] {19.0}
"The area within the operations boundary for the NSCR (defined as the reactor confinement building)." Which one of the following terms matches the above definition?

a. Emergency Support Center (ESC)

b. Emergency Planning Zone (EPZ)

c. Site Boundary

d. Controlled Access Area (CAA)

Answer: B.19 b.
Reference: Emergency Preparedness Plan Section 6.0

Question B.020 [1.0 point] {20.0}
Which ONE of the statements below describes the reason the lab receivers in the pneumatic system are kept closed except when loading or unloading a sample?

a. Prolonged opening will introduce air into the system and result in high levels of radioactive Ar^{41}.

b. Prolonged opening will cause pool leakage into the transport hoses due to the pressure differential.

c. They remain closed for neutron shielding purposes during reactor core operation.

d. They remain closed to prevent any CO2 leakage past the isolation valve from entering the labs.

Answer: B.20 a.
Reference: SOP IV-C.2, Pneumatic System Operation.

Section C Facility and Radiation Monitoring Systems

Question C.001 (1.0 points, 0.125 each) {1.0}
Match the beam port numbers in Column A with the Beam Port characteristics in Column B

Column A	Column B
a. BP 1	1. Tangential Beam Port, Stall Position.
b. BP 2	2. Radial Beam Port, Stall Position
c. BP 3	3. Beam Port in Main Pool
d. BP 4	4. Tangential Beam Port, (Modified Thermal Column)
e. BP 5	5. Removable extension normal to east face of reactor, (Modified Thermal Column)
f. BP 6	
g. BP 7	
h. BP 8	

Answer: C.01 a. = 1; b. = 2; c. = 2; d. = 1; e. = 3; f. = 4; g. = 5; h. = 4
Reference: SAR § VI.A.1 and 2. pp. 80 – 83.

Question C.002 (1.00 points) {2.0}
Which ONE of the following controls the amount of reactivity that is inserted by the transient rod during pulse operations?

a. The preset pulse timer setting that vents the pneumatic piston.
b. The pressure of the air applied to the pneumatic piston.
c. The reactivity of the reactor prior to firing the pulse.
d. The position of the cylinder.

Answer: C.02 d.
Reference: SOP II E, Pulsing Operation.

Section C Facility and Radiation Monitoring Systems

Question C.003 (1.00 point) {3.0}
The reactor is operating at 800 kW, with power being controlled by the servo control system. An experiment is inadvertently inserted into the core, causing reactor power to drop to 600 kW. As a result:

a. the reactor scrams.

b. regulating rod control shifts back to manual.

c. the regulating rod moves into the core to maintain power at 600 kW.

d. the regulating rod moves out of the core in an effort to restore power to 800 kW.

Answer: C.03 ~~a.~~ b. per facility comment
Reference: SAR, page 93.

Question C.004 (1.00 points) {4.0}
The chemical feed system controls the chemical characteristics of the:

a. purification system.

b. secondary cooling loop.

c. pool water cooling system.

d. pool water transfer system.

Answer: C.04 b.
Reference: SAR, page 65.

Question C.005 (1.00 points) {5.0}
When a compensated ion chamber is used for neutron detection at low power levels, how is the gamma flux accounted for?

a. Pulse height discrimination is used to eliminate the gamma flux.

b. The gamma flux is proportional to neutron flux and is counted with the neutrons.

c. The gamma flux is cancelled by creating an equal and opposite gamma current.

d. The gamma flux passes through the detector with no interaction because of detector design.

Answer: C.005 c.
Reference: SOP III C Linear Power Measuring Channel Maintenance Surveillance.

Section C Facility and Radiation Monitoring Systems

Question C.006 (1.00 points) {6.0}
Which ONE of the following is the method used for to generate the signal for the control rod position digital read outs on the control console?

a. A two channel encoder/decoder system produces 100 pulses per revolution.

b. A series of reed switches open/close as the rod moves generating a signal proportional to rod position.

c. A lead screw on the control rod varies the impedance between the two windings of a transformer generating a signal proportional to rod position.

d. A syncro transmitter within the control rod drive sends a signal to a servo receiver in the console, which generates the signal proportional to rod position.

Answer: C.06 a.
Reference: Modification Authorization M-46

Question C.007 (1.0 point) {7.0}
According to SOP II-C, "Reactor Startup," which one of the following anticipated power levels would require placing the diffuser system in operation?

a. 5 Kw

b. 10 Kw

c. 100 Kw

d. 500 Kw

Answer: C.07 d.
Reference: SOP II-C, p. 2.

Section C Facility and Radiation Monitoring Systems

Question C.008 (1.0 point) {8.0}
The reactor is operating at max allowed power (per SOP IV-F, Neutron Radiography Beam Port #4) while located in the stall and positioned against the radiography reflector. Select the statement that describes the indication[s] the operator would see in the control room if the shield door to enter the cave were to be opened.

a. The C-2 device would cause the reactor to trip and an alarm would sound.

b. The C-2 device would sound an alarm in the control room.

c. The beamport No. 4 area radiation monitor would alarm.

d. No indication in the control room.

Answer: C.08 a.
Reference: SAR p. 89, and SOP IV F p.2

Question: C.009 (1.00 points) {9.0}
Which one of the following statements describes the moderating properties of Zirconium Hydride?

a. The hydride mixture is very effective in slowing down neutrons with energies below 0.025 eV.

b. The ratio of hydrogen atoms to zirconium atoms affects the moderating effectiveness for slow neutrons.

c. The probability that a neutron will return to the fuel element before being captured elsewhere is a function of the temperature of the hydride.

d. The elevation of the hydride temperature increases the probability that a thermal neutron will escape the fuel-moderator element before being captured.

Answer: C.09 d.
Reference: GA - 3886 (Rev. A) TRIGA Mark III Reactor Hazards Analysis, Feb. 1965.

Question C.010 (1.00 points) {10.0}
Which one of the following areas is NOT directly monitored by a channel of the Area Radiation Monitoring System?

a. Reception area
b. Demineralizer room
c. Research Lab No. 1
d. Material handling area

Answer: C.10 a.
Reference: SAR IX-G, Fig. 9.3

Section C Facility and Radiation Monitoring Systems

Question C.011 (1.00 points) {11.0}
Which of the following is NOT an option provided by the Radioactive Liquid Waste Disposal System?

a. draining liquid waste to the creek
b. storing liquid waste for radioactive decay
c. evaporation and solidification of liquid waste
d. diluting liquid waste to comply with 10CRF20 limits

Answer: C.11 c.
Reference: SAR IX-B.2

Question C.012 (1.00 points) {12.0}
Mechanical stops prevent inadvertent movement of the NSCR closer than _____ from the irradiation cell window.

a. 12 ft
b. 8 ft
c. 18 inches
d. 3 inches

Answer: C.12 b.
Reference: SOP IV-E; SAR pg. 87

Question C.013 (1.00 points) {13.0}
The pneumatic sample system has several design features including:

a. An override so the control room can return a sample from the reactor to its origin.
b. Automatic return override if the samples get more exposure than expected.
c. The use of dry compressed CO_2 to minimize moisture in the system.
d. Control room permissive for each remote sample station.

Answer: C.013 d.
Reference: SOP IV-C

Section C Facility and Radiation Monitoring Systems

Question C.014 (1.00 point) {14.0}
Which one of the following provides a reactor scram in any mode of operation?

a. Low pool level.

b. High power level.

c. High fuel temperature.

d. Loss of supply voltage to high power level detector

Answer: C.14 c.
Reference: SAR, Table V pg. 100

Question C.015 (1.00 point) {15.0}
Under emergency conditions, the master control panel located in the reception room may be used to:

a. scram the reactor.

b. operate the air handling systems.

c. operate the emergency pool fill system.

d. operate the emergency lighting system.

Answer: C.15 b.
Reference: SAR, page 76.

Question C.016 (1.00 point) {16.0}
A reactor scram has occurred from an initial shim-safety rod position of 50.0%. Which one of the following correctly describes the indications for shim-safety rod #3 immediately following the scram? Assume no operator action.

a. ENGAGED light off, ROD DOWN light energized, CARR DOWN light off, digital indication 0.0%.

b. ENGAGED light off, ROD DOWN light energized, CARR DOWN light energized, digital indication 50.0%.

c. ENGAGED light off, ROD DOWN light energized, CARR DOWN light off, digital indication 50.0%.

d. ENGAGED light energized, ROD DOWN light off, CARR DOWN light off, digital indication 0.0%.

Answer: C.16 c.
Reference: SAR, pp. 26-29.

Question C.017 (1.00 point, 0.25 each) {17.0}
Identify whether each of the Reactor Safety Channels must be effective in the Steady State (SS) mode, the Pulse mode (PULSE), or both modes (BOTH)

a. Fuel Element Temperature

b. HI Power Level

c. Shim Safeties & Reg Rod Position

d. Pool Level

Answer: C.17 a. = BOTH; b. = SS; c. = PULSE; d. = BOTH
Reference: SAR Table V on page 100. Draft SAR, Table 7-1: Minimum Reactor Safety Channels

Question C.018 (1.00 point) {18.0}
When the stack particulate activity alarm sounds, which ONE of the following occurs?

a. The reactor scrams.

b. The evacuation alarm sounds.

c. The air handling system shuts down.

d. There are no automatic actions.

Answer: C.18 c.
Reference: SAR, page 119; Draft SAR, 7.7.2 Facility Air Monitors (pg 7-21)

Question C.019 (1.00 point) {19.0}
Which ONE of the following statements is NOT TRUE regarding the Servo Flux Control system?

a. Pressing the Gang-Up/Gang-Down switch will turn off the servo unit.

b. The regulating rod moves in response to the linear channel signal.

c. The regulating rod moves in response to the log power channel signal.

d. If power level drifts +/- 5% of the setpoint the servo unit will turn off.

Answer: C.19 c.
Reference: SOP Steady State Operation

Section C Facility and Radiation Monitoring Systems

Question C.020 (1.00 point) {20.0}
What type of detector is used to measure the amount of radiation exposure at the top of the pool due to N-16?

a. Gamma scintillator.

b. Geiger-Mueller tube.

c. Ionization chamber.

d. Proportional counter.

Answer: C.20 b.
Reference: SOP VII-B-7

***** END OF EXAMINATION *****